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Book Announcements

A. Berman, M. Neumann and R.J. Stern, Nonnegative Matrices in Dynamic Systems (Wiley, New York, 1989) 167 pages

Chapter 1: *Convex Sets*. Introduction. Convex sets and cones. Functions valued in a convex set. *Chapter* 2: *Matrix Theory Background*. Introduction. The Jordan and real canonical forms. Nonnegative matrices. M-matrices. The Frobenius normal form. *Chapter* 3: *Differential and Control System Preliminaries*. Introduction. Linear differential systems. Linear control systems: controllability, observability, and realizability. Glossary of models. *Chapter* 4: *Exponentially Nonnegative Matrices*. Introduction. Holdable closed convex sets: geometric considerations. Exponentially nonnegative matrices. *Chapter* 5: *Extended M-Matrices*. Introduction. Extended M-matrices. Further results. *Chapter* 6: *Cone Reachability*. Introduction. Basic properties of reachability cones. Cone reachability: simple cases. Cone reachability: the case of a real spectrum. The boundary of the reachability cone. Cone reachability for discrete approximations to the differential equation. *Chapter* 7: *Applications to Feedback Control*. Introduction. Feedback holdability of R_+^n. Controllability to R_+^n. A stabilizability-holdability problem. *Chapter* 8: *Controllability, Observability, and Realizability of Positive Control Systems*. Introduction. Controllability with nonnegative controls. Observability with conical observation set. Positive realization.

L. Lovasz, An Algorithmic Theory of Numbers, Graphs and Convexity (SIAM, Philadelphia, PA, 1989) 91 pages

Chapter 1: *How to Round Numbers*. Preliminaries: On algorithms involving numbers. Diophantine approximation. Problems. Lattices, bases, and the reduction problem. Diphantine approximation and rounding. What is a real number? *Chapter* 2: *How to Round a Convex Body*. Preliminaries: Inputting a set. Algorithmic problems on convex sets. The Ellipsoid Method. Rational polyhedra. Some other algorithmic problems on convex sets. Integer programming in a fixed dimension. *Chapter* 3: *Some Applications in Combinatorics*. Cuts and joins. Chromatic number, cliques, and perfect graphs. Minimizing a submodular function.

H.M. Salkin and K. Mathur, Foundations of Integer Programming (North-Holland, New York, 1989) 743 pages

Chapter 1: *Introduction to Integer Programming*. Linear programs with integer variables. Uses and applications (Formulations that allow integer variables. Classical applications and case studies). *Chapter* 2: *Review of Linear Programming*. The linear programming problem. Graphical solution and geometric concepts. The simplex algorithm (Definitions. Fundamental theorems. The simplex algorithm. The two-phase simplex method). The revised simplex algorithm. Duality in linear programming. The dual simplex algorithm. The Beale tableau. *Chapter* 3: *Using Linear Programming to Solve Integer Programs*. Graphical solutions to mixed integer or programs. Solving an integer programming problem as a linear program (Unimodularity). Obtaining integer programming solutions by rounding linear programming solutions. An overview of approaches for solving integer (or mixed-integer) problems (Cutting plane techniques (Chapters 4, 5, 6, 7). Enumerative methods (Chapters 8, 9). Partitioning algorithms (Chapter 10). Group theoretic algorithms (Chapter 11)). *Chapter* 4: *Dual Fractional Integer Programming*. The basic approach. Notation: The Beale tableau. The form of the (Gomory) cut. Illustrations. The derivation of the cut (Congruence. Derivation). Some properties of added inequalities. Algorithm strategies (Number of possible inequalities. Choosing the source row. Dropping inequalities). A geometric derivation. Finiteness. Appendix A: Convergence using the Dantzig cut. Appendix B: A variation of the basic approach: The accelerated Euclidean algorithm. Appendix C: Geometrically derived cuts. *Chapter* 5: *Dual Fractional Mixed Integer Programming*. The basic approach. The form of the cut. An illustration. The derivation of the cut. Applying the mixed cut to the integer program. Finiteness. *Chapter* 6: *Dual All-Integer Integer Programming*. The basic approach. The form of the cut (The rules for finding λ). Illustrations. Derivations: The form of the cut, the Pivot column, and the λ selection rules (The form of the cut. Choosing the Pivot column. λ selection rules). Some properties of the added inequalities (The relative strength of the added inequalities. A second derivation of the fractional cut, and relation to the all-integer cut). Algorithm strategies (Choosing the source row. Dropping inequalities). Finiteness (If only the cost row is all-integer). *Chapter* 7: *Primal All-Integer Integer Programming*. Introduction. The tableau, the rudimentary primal algorithm (The rudimentary algorithm. The rudimentary primary algorithm). A convergent algorithm: The simplified algorithm (SPA) (Modifications 1 and 2: Introducing a reference row and selecting the Pivot column. Modification 3: Acceptable source row selection rules. The simplified primal algorithm (SPA)). A second reference equation: Using the dual variables. Illustrations (SPA). Optimality without dual feasibility. Convergence (Finiteness under Rule 1. Finiteness under Rule 2. Finiteness under Rule 3). *Chapter* 8: *Branch and Bound Enumeration*. Introduction. The problem, notation, and the basic result (The problem, notation. The basic result and geometric interpretations). The enumeration tree, algorithm formulation, an example (The tree, algorithm formulation. An example). The basic approach, a second example (The basic approach. A second example). A variation of the basic approach. Specialization for the zero-one problem. Node selection, branching rules, and penalties (Node selection. Branching rules and penalties). Appendix A: Computational details of Examples 8.3 and 8.4. *Chapter* 9: *Search Enumeration*. Introduction. The basic approach, the tree (The basic approach. The tree). The point algorithm: Implicit enumeration criteria (Ceiling tests. Infeasibility test. Cancellation zero test. Cancellation one test. Linear programming. Post-optimization, penalties. Surrogate constraints). The point algorithm: Branching strategies (Preferred sets. The Balas test. Other branching rules). The generalized origin, restarts. Search enumeration 0–1 mixed integer programming. Appendix A: A sample search algorithm and its implementation (The basic approach; the point algorithm. The bookkeeping scheme). Appendix B: Computational experience (Program description). *Chapter* 10: *Partitioning in Mixed Integer Programming*. Introduction. Posing the mixed integer program as an integer program. The partitioning algorithm. Properties of the partitioning algorithm. Finiteness. Appendix A: Application of the partitioning algorithm to the uncapacitated plant location problem (Problem [P1]'s equivalent integer program [I]. Solving the linear program [DL]. Summary of the partitioning algorithm. An illustrative example). *Chapter* 11: *Group Theory in Integer Programming*. Introduction. The group minimization problem (The group $G(\bar{\alpha})$. Solving the GMP). Solving the group minimization problem (Dynamic programming algorithms. A sufficient condition for $\mathbf{x_B} \geq \mathbf{0}$. An enumeration algorithm). The group minimization problem viewed as a network (Formulation. Solving the integer program by solving the network problem). An equivalent group minimization problem. The isomorphic factor group $G(\mathbf{A})/G(\mathbf{B})$ (Definitions, results. The isomorphic groups $G(\bar{\alpha})$ and $G(\lambda)$. The subgroup decomposition of $G(\mathbf{A})/G(\mathbf{B})$. The order of $G(\bar{\alpha})$ and $G(\lambda)$). The geometry (The corner polyhedron $\mathbf{x}'$ space). The corner polyhedron ($\mathbf{x_N}$ space). Relating the corner polyhedra. The master (corner) polyhedron. Generating valid inequalities from the faces of master polyhedra). Appendix A: A shortest route algorithm (Specialization of the shortest path algorithm for the group minimization problem). Appendix B: Diagonalizing the basis – Smith's normal form. Appendix C: Computational experience (Computer programmed group minimization algorithms (A dynamic programming algorithm. Branch and bound algorithm. Shortest route algorithms)). (Reducing the order of the group (Scaling. Relaxation. Decomposition)). Appendix D: Implementation of a group theoretic algorithm (Linear programming module. Construction of FGMP. Solution of FGMP.

Branch and bound algorithm (Node selection rule. Implicit branching rule. Node omission rule. Combining the implicit branching rule and the node omission rule)). *Chapter* 12: *The Knapsack Problem.* Introduction. Applications and uses of knapsack and related problems (Capital budgeting. The cutting stock problem. Loading problems. Change making problem. Other uses). Reducing integer programs to knapsack problems: Aggregating constraints (An aggregation process. An improved aggregation process). Algorithms (Dynamic programming techniques. A periodic property. Branch and bound algorithms: General knapsack problem. Lagrangian multiplier methods. Network approaches). Branch and bound algorithms: 0–1 knapsack problem (The linear programming solution. The upper bound solution. The lower bound solution. Reduction algorithm. The branch and bound algorithm). *Chapter* 13: *The Set Covering Problem, the Set Partitioning Problem.* Introduction. Set covering and networks (The node covering problem. The matching problem. Disconnecting paths. The maximum flow problem). Applications (Airline crew scheduling. Truck scheduling. Political redistricting. Information retrieval). Relevant results. Algorithms (A search algorithm for the set partitioning problem. A search algorithm for the set covering problem). Appendix A: Computational experience (Cutting plane algorithms. Enumerative algorithms. Summary). *Chapter* 14: *The Fixed Charge Problems: The Plant Location Problem and Fixed Charge Transportation Problem.* Introduction (The plant location problem. The fixed charge transportation problem). Algorithms for the plant location problem (A branch and bound algorithm for the fixed charge problem. A branch and bound algorithm for the plant location problem). Branch and bound algorithm for the fixed charge transportationproblem. Appendix A: Computational experience (The general fixed charge problem. The fixed charge (or capacitated plant location) problem. The (uncapacitated) plant location problem. Summary). *Chapter* 15: *The Traveling Salesman Problem.* Introduction. Mathematical formulation. Algorithms (Bounding rules. Branching rules). Approximate algorithms (Tour construction procedures. Tour improvement algorithms). Appendix A: The assignment algorithm. Appendix B: Some counterexamples to heuristic algorithms for the traveling salesman problem (Cheapest insertion algorithm (nonsymmetric case). Cheapest insertion algorithm (symmetric case). Convex hull heuristic. Two edge interchange (2-opt) algorithm).

H.S. Wilf, Combinatorial Algorithms: An Update (SIAM, Philadelphia, PA, 1989) 45 pages

Chapter 1: *The Original Gray Code. Chapter* 2: *Other Gray Codes. Chapter* 3: *Variations on the Theme. Chapter* 4: *Choosing 2-Samples. Chapter* 5: *Listing Rooted Trees. Chapter* 6: *Random Selection of Free Trees. Chapter* 7: *Listing Free Trees. Chapter* 8: *Generating Random Graphs.*

R.J. Wilson and J.J. Watkins, GRAPHS, An Introductory Approach (Wiley, New York, 1990) 333 pages

Chapter 1: *What is a Graph?* Introduction. The definition of a graph. The degree of a vertex. Isomorphic graphs. Counting graphs. The graph cards. *Chapter* 2: *Definitions and Examples.* Adjacency and incidence. Paths and cycles. Examples of graphs. *Chapter* 3: *Applications of Graphs.* Chemistry. Social sciences. Trees. Bracing rectangular frameworks. Compatibility and interval graphs. The four-cubes problem. Music. *Chapter* 4: *What is a digraph?* Introduction. The definition of a digraph. Adjacency and incidence. Paths and cycles. *Chapter* 5: *Applications of Digraphs.* Signed digraphs. Finite state machines. Signal-flow graphs. *Appendix.* Proofs. Methods of proof. PART II: INTRODUCTION. *Chapter* 6: *Eulerian Graphs and Digraphs.* Introduction. Eulerian graphs. Eulerian-type problems. *Chapter* 7: *Hamiltonian Graphs and Digraphs.* Introduction. Hamiltonian-type problems. *Chapter* 8: *Path Algorithms.* Introduction. The shortest path algorithm. The longest path algorithm. Scheduling. *Chapter* 9:

Connectivity. Edge-connectivity. Vertex-connectivity. Menger's theorem for graphs (edge-form). Some analogs of Menger's theorem. The proof of Menger's theorem. *Chapter* 10: *Trees*. Mathematical properties of trees. Spanning trees. Centers and bicenters. Counting trees. Searching trees. Constructing trees. The knapsack problem. *Chapter* 11: *Planarity*. Introduction. Planar graphs. Euler's formula. Testing for planarity. Duality. *Chapter* 12: *Coloring Graphs*. Vertex-colorings. Chromatic polynomials. Edge-colorings. *Chapter* 13: *Coloring Maps*. Introduction. The four-color problem. Equivalent forms of the four-color theorem. Graph embeddings and the heawood map-coloring theorem. *Chapter* 14: *Decomposition Problems*. Introduction. Vertex decomposition problems. Edge decomposition problems. Summary. *Chapter* 15: *Conclusion*. Primary and secondary applications. Four types of problems. The future. Suggestions for further reading.